1. Some of our favorite expressions:

Please use the speed of light $c = 3.0 \times 10^8$ m/s.

"**Moving objects shrink**" by a factor of $1/\gamma$ and "**Moving clocks run slow**" by a factor of γ where

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}.$$

v/c in terms of γ is

$$\frac{v}{c} = \sqrt{1 - \frac{1}{\gamma^2}}$$

"**Simultaneity slips**" The time in a moving frame between simultaneous events in another frame is

$$T = \frac{vD}{c^2}$$

The details: If events E_1 and E_2 are simultaneous in one frame then in a frame moving with speed v in the direction from E_1 to E_2, the event E_2 occurs earlier than E_1 by the time interval Dv/c^2, where D is the distance between the events in the second frame.

"**Velocity addition is modified**". An object moves at u in a frame. In another frame moving at v with respect to this frame, the object moves at w given by

$$w = \frac{v + u}{1 + uv/c^2}$$

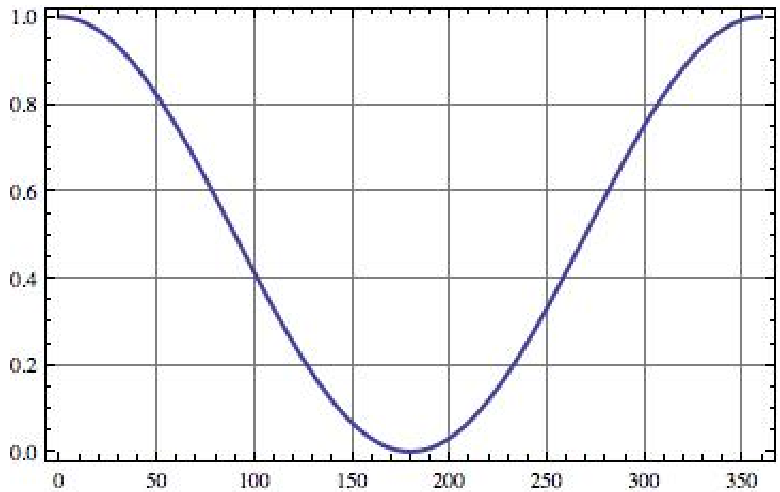
"**Light changes color**" For observers with relative velocity v

$$K = \frac{T'}{T} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}} = \gamma + \sqrt{\gamma^2 - 1} = z + 1$$

where T' is in the frame that receives the light, T is in the frame that emits light. For receding observers $v > 0$, for approaching observers $v < 0$. The speed in terms of K is given by

$$\frac{v}{c} = \frac{K^2 - 1}{K^2 + 1}$$

The probability chart $P(m_\theta = +m_B | m_z = +m_B)$ vs. θ



Quantum Mechanics The probability for a system to transition from state A to state B is found by

(1) **Find the paths** List the exclusive, exhaustive ways or paths to transition from A to B.
(2) **Assign amplitudes** Determine the amplitudes for each path.
(3) **Add amplitudes** Add the amplitudes for all possible paths "tip to tail".
(4) **Square to probability** Then the square of the length of the total amplitude is the probability for the transition.

"**Gravity slows clocks**" Alice and Bob are near a massive object that accelerates objects at g. If Alice is a height h above Bob then when Alice's clock clicks off T_A then Bob's clock ticks off T_B

$$T_B = T_A \left(1 - \frac{gh}{c^2}\right)$$

(to leading order).
The Schwarschild radius of a black hole of mass M is

$$r_s = \frac{2GM}{c^2}$$

where is Newton's gravitational constant.
The Hawking temperature of a black hole of mass M is, in degrees Kelvin,

$$T_H = 6 \times 10^{-8} \frac{M_\odot}{M}$$

where $M_\odot$ is the mass of the sun.